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AN EVALUATION OF LIBERALIZED DISTRIBUTION OF DISEASE CONTROL PERMITS FOR WHITE-TAILED DEER, 2008-2010

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ABSTRACT

Disease control permits were created in 1998 to assist agricultural landowners in managing deer on their property in areas with documented cases of bovine tuberculosis (TB) in free-ranging deer. In November 2007, amendments were made to the permit program which expanded the number and types of landowners eligible to receive the permits, and liberalized permit distribution. Over the period 2008-2010, >2300 permits with >13,000 kill tags were distributed. For agricultural producers in the TB endemic area, liberalized distribution increased the annual availability of permits and kill tags ~15X and ~10X respectively. In all, 2,792 deer were killed on disease control permits during the period. Seventeen (0.6%) were TB-positive. The area/landowner group for whom permits were most easily available (agricultural producers in the five county TB endemic area) had the highest participation and killed the most deer in terms of raw numbers, but also had the lowest participation rate (38%), proportion killing deer (24%) and proportion of available kill tags filled (15%). In the endemic area, liberalized distribution did not significantly increase the deer kill, nor the number of TB-positive deer killed. Regression modeling showed little evidence that liberalized distribution was associated with a decrease in transmission of TB to cattle. Where permittees were allowed to take deer during regular hunting seasons, the majority did so; 60-76% of permittees who shot deer took them only between October 1 and December 31. There was a significant decrease in the proportion of agricultural landowners in the TB endemic area who purchased deer hunting licenses during the period, and those who did purchased significantly fewer. Liberalized distribution reduced DNR wage costs minimally (<3%), but reduced staff hours expended more substantially (34%).

INTRODUCTION

Disease control permits (DCPs) for white-tailed deer (*Odocoileus virginianus*) were originally established by the Natural Resources Commission (NRC) in the Wildlife Conservation Order (WCO) by Amendment 6 of 1998 (WCO, 1998) as "bovine tuberculosis (TB) control permits." Disease control permits were created to assist agricultural landowners in managing deer on their property in a county with one or more documented cases of TB in free-ranging deer (Memorandum to the NRC, 2007), or lands within 30 miles of such a case (WCO, 1998). The intended purpose of DCPs is to prevent deer from comingling with cattle or accessing cattle feed, either stored or in feed bunks (Matthews, 2007), in order to reduce the risk of indirect transmission of TB.

Disease control permits can be thought of as a special type of, and distinguished from, other Out of Season (OOS) shooting permits for deer, principally Deer Damage Shooting permits. Deer damage shooting permits may be issued statewide to landowners with "significant agricultural or horticultural crop damage" documented by the Michigan Department of Natural Resources (DNR). While DCPs and OOS permits have many of the same provisions (see sections 5.41-5.44 and 5.76-5.79 in WCO, 2011), some differences exist, principally, that deer damage shooting permits are typically not valid during autumn hunting seasons. Disease Control Permits should also be differentiated from Deer Management Assistance (DMA) permits, which are essentially additional antlerless deer hunting licenses, purchased by the landowner, for use where there is documented agricultural or horticultural crop damage caused by deer, where a serious disease outbreak is a threat to deer, livestock, or human health, where a significant safety hazard from deer exists, or where "current antlerless regulations are insufficient to achieve landowner deer management objectives" (WCO, 2011, sec. 5.80 *et seq*.). Being hunting licenses, DMA permits are only valid for use during regular deer hunting seasons, and the permittee must also purchase a deer hunting license.

The initiative for obtaining DCPs originated with the agricultural producer, *i.e*., it was originally the responsibility of the farmers to request them (Matthews, 2007). Like other OOS permits, DCP program was originally administered entirely in the field, with habitat biologists and the Wildlife Management Unit (WMU) supervisor given considerable discretion in the issuance and specifications of the permit. During periods open for deer hunting, "field shooting" (shooting of deer away from cattle and feed storage areas) has typically not been allowed.
Originally, the duration of DCPs was left to the discretion of field staff. Typically, a permit was granted for 30 days, with extensions via telephone request normally approved (Matthews, 2007). Field staff tried to respond to permit requests quickly. In most instances, mailing the permit material was judged satisfactory to the livestock producer. The familiarity of field staff with many livestock operations often made a site visit unnecessary, although visits were sometimes conducted if they did not result in a significant delay processing the permit.

On a case by case basis, provisions designed to facilitate flexibility of use for the permittee can be included in the DCP, as in other OOS permits. The permits may be used after dark in order to kill nocturnal deer visiting cattle housing or feed storage areas, if night shooting is judged safe by the WMU supervisor and DNR Law Enforcement Division (LED). The number of individuals designated on the permit as legal shooters (other than the permit holder) may be increased from the original three, and also extended to agents of the United States Department of Agriculture Animal and Plant Health Inspection Service's Wildlife Services (USDA APHIS-WS) branch. Carcasses of deer that have been shot must be salvaged for food, with heads submitted to the DNR for TB testing if specified on the permit. Unlike other OOS permits, however, taking of antlered bucks on DCPs is allowed, although antlers may not be retained by the permitee.

Regulations for DCPs were amended in May 2003 in order to expand the definition of "disease," and so the scope of the permits, beyond just bovine TB to chronic wasting disease (CWD, following the discovery of CWD in Wisconsin in 2002), or to "other disease in deer as determined by the director" (WCO, 2011, sec. 5.76(5)(c)).

The exact impetus for amendments made to the DCP program in November 2007 is somewhat obscure. A communication from the acting Division Chief (Reeves, 2008) noted that the initiative was set in motion as the DNR and the Michigan Departments of Agriculture (MDA) and Community Health worked through the findings of a USDA review of the bovine tuberculosis eradication program. "It is being done to assist in further reducing the incidence of bovine tuberculosis in the deer herd and to make it easier for cattle producers to receive and use the permits to control deer numbers on their farms. It may also help reduce the risk of transmission of TB from free-ranging deer to cattle." Wildlife Division (WLD) field staff from the Northeastern Management Unit (NEMU) recall a number of complaints from a particularly vocal Presque Isle County cattle producer having preceded discussion of the amendments. In addition, both the DNR Director and the Chairman of the NRC advocated for the changes internally.

Whatever the proximate cause, the 2007 amendments changed the definition of landowners eligible to receive DCPs from agricultural landowners to any landowner in a county with a confirmed case of TB, or within 30 miles of a confirmed case of TB, even if their residence was outside of the county. This expanded definition extended use of DCPs to non-farmers, considered a potentially a useful addition in some high TB prevalence areas in Deer Management Unit (DMU) 452. Although some had apparently never considered the implications of the 30 mile radius rule when it was instituted in 1998, it effectively opened most of the northern half of the lower peninsula to the issuance of DCPs (Figure 1). In addition, the 2007 amendment replaced the plastic seal used to tag deer with the same tag used for deer damage shooting permits, and eliminated the requirement of possessing a valid deer hunting license to utilize a DCP during a deer season (meaning that in specified areas, the DCPs now allowed take of deer in season without cost to the landowner).

Perhaps the most obvious change accompanying the 2007 amendments was the distribution system for DCPs, which, at the specific request of the DNR Director and the NRC, was transferred from field staff to the DNR Wildlife Disease Laboratory (WDL). The primary reason for this change was apparently the opinion expressed by agricultural producers and their advocacy groups that DCPs were too difficult to obtain, with the process placing too heavy a burden on cattle producers.

Beginning December 2007, mass mailings were made from the WDL to the following groups:

1. All commercial beef cattle, dairy cattle and bison producers in the five county (Alcona, Alpena, Montmorency, Oscoda, Presque Isle) TB endemic area. The herd classifications and address list were obtained from the Animal Industry Division (AID), MDA. Specifically excluded from this unsolicited distribution of DCPs were producers of "freezer beef" (cattle raised in small numbers, generally for family consumption, that do not enter the commercial food chain); dairy goats; and cattle raised solely as 4H animals. Each addressee was sent: a letter describing the program and its requirements (Addendum 1); 5 kill tags with attached TB testing tags; two copies of a DCP (one to be signed and returned to the Lab, the other to be retained for the permittee's records); a postage-paid envelope addressed to the WDL; a handout illustrating gross lesions of TB; and a handout describing where heads from deer shot on DCPs could be dropped off for shipment to WDL for testing.

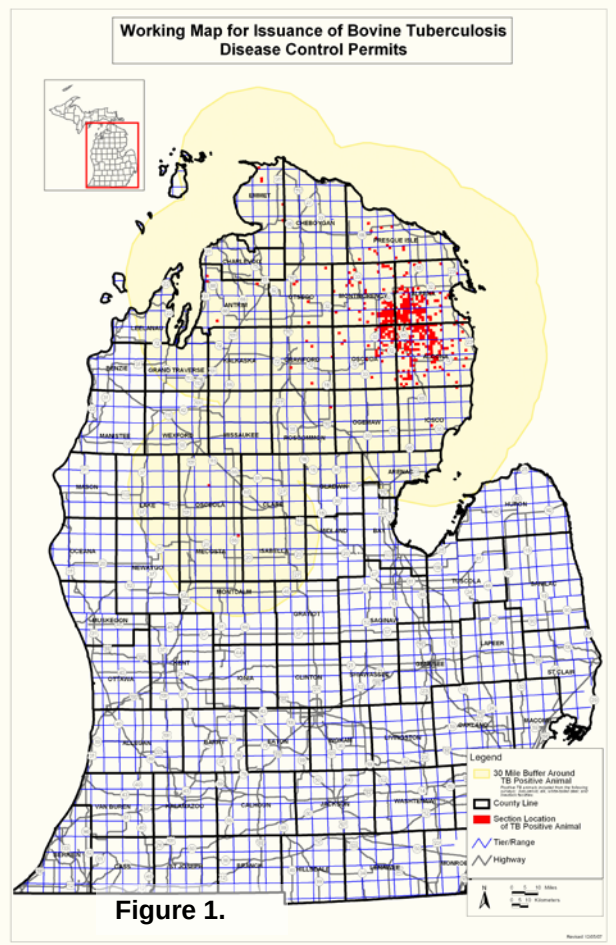

Figure 1.

2. Selected non-agricultural private landowners in DMU 452. The audience being sought was essentially deer hunt clubs and owners of recreational land likely to be used for deer hunting in the core TB area. The mailing list was compiled with input from WLD field staff. Arbitrarily, an eligibility cutoff of 30 acres or greater was set. Each addressee was initially sent only a letter describing the program and its purpose that invited them to apply for a DCP. At the request of the NRC Chairman, the list was expanded in 2009 by examining county tax evaluation records for names that sounded likely to denote hunt clubs.

Subsequently, letters of invitation to apply for DCPs were also mailed to:

1. Commercial beef, dairy and bison producers listed by MDA as having previously been tested for TB located within 10 miles of a TB-positive free-ranging deer diagnosed in Shiawassee County (T6N R2E) in January, 2008.
2. All landowners in a 9 township area (Algoma, Alpine, Cannon, Courtland, Nelson, Plainfield, Solon, Sparta, Tyrone) surrounding the captive cervid facility where a chronic wasting disease (CWD)-positive captive white-tailed deer was diagnosed in August 2008. These DCPs were issued because of CWD rather than TB, and they will not be treated further in this evaluation.

Initially, on mutual agreement of WLD field staff and the WDL, issuance of DCPs outside the 5 county TB endemic area continued to be handled by field staff according to their established protocols. However, in summer 2008, an *ad hoc* committee incorporating DNR staff from WLD and LED, as well as various stakeholder groups, was formed to deal with objections that arose regarding who was eligible to receive DCPs and who was not. A product of that committee, guidelines for issuance of DCPs through 2010, is included in Table 1. As a result of those discussions, beginning in 2009 letters of invitation to apply for DCPs were also mailed to:

3. Commercial beef, dairy and bison operations in the remaining counties that were considered by USDA APHIS Veterinary Services (VS) branch to be at an elevated risk of TB transmission (**Methods,** *Data*, below), viz., Antrim, Charlevoix, Cheboygan, Crawford, Emmet, Iosco, Ogemaw, and Otsego)

Additionally, in 2007, a set of operating protocols for administration of the DCP program at the WDL was established, including establishment of communications channels (dedicated phone line and e-mail address for DCP issues), databases for tracking permittee information and distribution of DCPs, and maintenance of reporting obligations to legislators (e.g., Fierke, 2008). Reports to Senator Gillard were mandated monthly through 2008, then quarterly

thereafter. Further documentation of program administration is available from the authors on request.

At the November 8, 2007 meeting of the NRC Policy Committee on Wildlife and Fisheries, Commissioner Mary Brown requested that the WLD conduct an evaluation of the changes made to the distribution system for DCPs and their use after a period of 3 years if the proposed amendments were approved by the NRC (NRC, 2007). Fulfillment of that obligation to Commissioner Brown and the NRC is the purpose of this Division Report.

METHODS

Data. At the time liberalized distribution was initiated in January 2008, Michigan was zoned by the USDA APHIS Veterinary Services (VS) branch into three zones of TB accreditation status for cattle. The zone with the lowest status, referred to as the Modified Accredited Zone (MAZ), had boundaries that included all the same counties as DNR WLD's NEMU, with the exception of Roscommon (*i.e*. Alcona, Alpena, Antrim, Charlevoix, Cheboygan, Crawford, Emmet, Iosco, Montmorency, Ogemaw, Oscoda, Otsego and Presque Isle). This commonality provided a convenient and administratively-meaningful demarcation of areas for analysis. These counties encompass the area from which all the TB-positive livestock, and all but four of the 686 TB-positive free-ranging deer, have come. Thus, they effectively comprise the entire known area where TB transmission from deer to cattle could be considered a proximate risk for the 2008-2010 period.

Names, street addresses and herd types for livestock operations were obtained from MDA AID. Data regarding the issuance of DCPs (contact information, type of livestock operation, geographic location, assigned kill tag numbers, names of shooters designated by the permittee, dates permits/tags were mailed, returned, and that notification of kills was received) were maintained in electronic spreadsheets (Excel 2003, Microsoft Corporation, Redmond, WA) housed on network drives to which WDL, WLD field staff, and LED staff all had access. A separate spreadsheet accounted for which kill tags were filled, the age, sex and TB status of the deer taken on that tag, the date of the kill, and the TB test tag number assigned to each kill tag. To the extent that specific producers returned or reported having destroyed particular kill tags, these were also recorded.

Data on OOS permits issued between 1998 and 2006 (or between 2001 and 2006 for agricultural producers in the MAZ outside of the five county endemic area) were used as a comparison for DCP data recorded during the period of liberalized distribution. These were obtained from NEMU staff in Gaylord. Similar data were obtained for Shiawassee County from the South Central Management Unit office at Rose Lake. To compare relative costs of administering the DCP program in the field versus at the WDL, data on staff hours, wages and salaries devoted to TB from January through August 2001-2010 were obtained from the NEMU for field staff, via the State of Michigan's Data Collection and Distribution System (DCDS). Data were restricted to the January to August period because the vast majority of work coded to TB during that period was considered likely to have been DCP-related (G. Matthews, personal communication). Comparable data for WDL staff were kept track of internally as a subset of all work coded to TB yearround 2008-2010. Hunting license purchase histories of DCP holders in the five county TB endemic area between 2007 and 2010 were obtained from the DNR retail sales system (RSS).

Statistical analyses. For purposes of statistical analysis, DCPs issued were divided into four different area/landowner types: 1) agricultural (primarily cattle, goat and bison) producers in the five county TB endemic area; 2) agricultural producers outside the five county area but within

the MAZ; 3) non-agricultural landowners in DMU 452; and 4) agricultural (primarily cattle, goat and bison) producers in Shiawassee County. To facilitate transparent and relevant interpretation, analyses are organized herein to address particular principal questions that were raised as potential justification for liberalized distribution of DCPs, or as a result of liberalized distribution.

Differences in the mean numbers of deer taken, permittees taking deer, signed permits returned to DNR by the prospective permittee, and permittees requesting more kill tags (because all those issued to them had been filled) across area/landowner types were assessed via the Kruskal-Wallis (K-W) Test (Sokal and Rohlf, 1995, pp. 423-427). Comparisons of the proportions of issued kill tags filled, and of permittees taking deer, returning signed permits, and requesting more kill tags across area/landowner types were analyzed via contingency tables (chi-squared and Fisher's exact test for expected cell frequencies ≥5 and <5, respectively; Thrusfield, 1995, pp. 211-214). The same tests were also used to assess differences in those variables within each area/landowner type during the period of liberalized DCP distribution (2008-2010) compared to OOS permits issued 1998-2006. The mean annual number of deer taken between the two time periods within area/landowner types was compared via a two-sample Wilcoxon ranked sum test (Sokal and Rohlf, 1995, pp. 427-431).

To test the proposition that use of DCPs "may also help reduce the risk of transmission of TB from free-ranging deer to cattle" (Reeves, 2008), the number of annual cattle herd infections were analyzed via Poisson regression analysis (Kleinbaum et al., 1998, pp. 687-709). Cattle herd infections in Michigan can be considered a rare event, and so were assumed to follow a Poisson distribution. Generalized linear models of the form:

$$\mathrm{Ln}\{n_i\} = \mathrm{Ln}\{N_i\} + \mathbf{x'_i}\,\boldsymbol{\beta}$$

were fitted using iteratively reweighted least squares and a logarithmic (Ln) link function, where n_i was the number of positive herds, N_i was the number of whole herd TB tests (an offset variable with an unestimated [β = 1] parameter), and x_i were linear predictors. Depending on the model, predictors included the timeperiod associated with DCP distribution (binary: 0 = historical [1998-2007], 1 = liberalized [2008-2010]), and/or annual apparent prevalence of TB in free-ranging white-tailed deer (proportion). Because the vast majority of cattle farms (44 of 51; 86%) diagnosed as TB infected 1998-2010 were in the TB endemic area, those five counties and the MAZ counties outside the five county area were analyzed separately. Information-theoretic methods were used to assess model fit and select an optimal model (Burnham and Anderson, 1998). Intercept terms, covariates and variance were counted towards the number of estimable parameters K for each model. Since count data with the potential for overdispersion were being modeled, variance inflation factors for global models were examined. Because both were ≈ 1, QAICs were not used (Burnham and Anderson, 1998, p. 72).

All statistics were implemented using freely available software (R version 2.10.0, R Foundation for Statistical Computing, 2009, http://www.r-project.org/).

RESULTS

The locations of DCPs issued and deer tested for TB during the period of liberalized distribution are depicted in Figure 2.

How did the use of DCPs during liberalized distribution compare across area/landowner types? Both the number of deer taken (K-W χ^2 = 9.66, df = 3, p = 0.02) and the number of permittees

taking deer (K-W χ^2 = 9.84, df = 3, p = 0.02), varied significantly across DCP area/landowner types, with five county agricultural producers showing the highest frequencies in all cases (Table 3). Similar findings were noted for numbers of signed DCPs returned to DNR (K-W χ^2 = 9.97, df = 3, p = 0.02) and permittees requesting additional kill tags (K-W χ^2 = 9.45, df = 3, p = 0.02). In all likelihood, this was because five county producers were issued far more permits and kill tags, more than those issued to the other three area/landowner types combined.

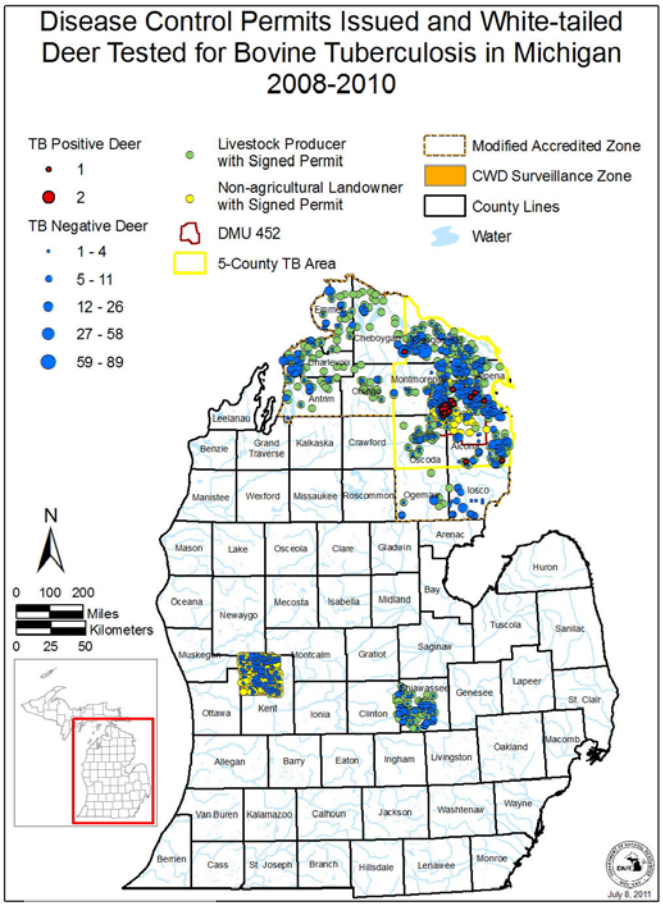

Figure 2.

However, as a proportion of the mean annual kill tags issued (χ^2 = 112.6, df = 3, p < 0.0001) and mean annual signed permits returned to DNR (χ^2 = 10.6, df = 3, p = 0.01), respectively, five county agricultural producers reported having killed significantly fewer deer, the lowest proportion of any area/landowner type to whom DCPs were issued. There was also significant variation in the proportion of landowners issued DCPs who returned a signed permit to DNR as legally required (χ^2 = 18.1, df = 3, p = 0.0004), and the proportion requesting more kill tags (Fisher's exact, two-tailed p = 0.01). Agricultural producers in the five county TB endemic area had the lowest mean annual return rate (38%), and also requested additional kill tags at the lowest rate (4%). Efforts to kill deer in the various area types could have been affected by varying deer abundance.

Did liberalized distribution of DCPs result in significantly more deer being killed in the endemic area? The mean annual pre-hunt deer population estimate (based on sex-age kill modeling; Mattson and Moritz, 2008) and deer harvest for the five county area 2008-2010 were estimated at 104,642 (B. Rudolph, DNR-WLD, unpublished data) and 32,467 (DMIS, 2011), respectively. Compared to the annual average of 90 deer reported killed on DCPs by five county agricultural producers from 1998-2006, the annual average of 477 deer reported killed on DCPs 2008-2010, added to the estimated harvest, amounted to a 0.3% increase in deer kill for a population of this size. That increase was not significant statistically (χ^2 = 3.3, df = 1, p-value = 0.07). Expressed as the odds of an individual deer being killed, liberalized distribution of DCPs only increased those odds by a factor of 0.02 (Odds ratio = 1.02, 95% confidence limits: 1.00 , 1.04) over what they would likely have been under historical DCP distribution.

Amongst those five county agricultural producers who held DCPs and reported shooting at least one deer at some time during the three year period of liberalized distribution, the median number of deer reported shot was 3 (range: 1-91, first quartile = 1, third quartile = 5). Among MAZ agricultural producers outside the five county area, the median 2009-2010[1] was only slightly higher (4; range: 1-63, first quartile = 2, third quartile = 6). In other words, for DCP

[1] Data from 2008 were not available for MAZ counties outside the five county TB endemic area.

holders across the entire MAZ who used their DCPs, 75% shot 6 deer or less over the combined years of liberalized distribution, or ≤3 deer per year. By way of comparison, 97±0.4% of deer hunters statewide who harvested a deer in 2010 took ≤3 deer (B. Frawley, MDNR Wildlife Division, unpublished data).

How did the use of DCPs during liberalized distribution compare to their historic use? Within each of the three area/landowner groups for which historical OOS shooting permit data were available for comparison, liberalized distribution of DCPs resulted in a significantly larger deer kill than was achieved during 1998-2006 (five county agricultural producers, $p = 0.018$; MAZ agricultural producers outside the five counties, $p = 0.024$; Shiawassee agricultural producers, $p = 0.024$). Notably, the average number of both DCPs and kill tags issued per year during the liberalized distribution period were between 3 and 15X higher than numbers of OOS shooting permits issued between 1998 and 2006 (Table 3), depending on area/landowner type. However, the annual average proportion of kill tags actually used was significantly lower under liberalized distribution across all agricultural landowner types (five county agricultural producers, $\chi^2 = 30.7$, df = 1, $p < 0.0001$; MAZ agricultural producers outside the five counties, $\chi^2 = 5.4$, df = 1, $p = 0.02$; Shiawassee agricultural producers, $\chi^2 = 8.0$, df = 1, $p = 0.005$).

Historically, OOS shooting permits were issued at the field level in such a way that all permits issued were validly signed, as required by regulations. In other words, no permit was issued by WLD staff without the landowner agreeing to the permit conditions via his/her signature on the permit. Compared to OOS shooting permits issued 1998-2006, liberalized distribution resulted in significantly lower proportions of DCPs signed and returned among five county agricultural producers ($\chi^2 = 16.6$, df = 1, $p =< 0.0001$), but not MAZ agricultural producers outside the five counties ($\chi^2 = 2.0$, df = 1, $p = 0.16$) or Shiawassee agricultural producers ($\chi^2 = 0.37$, df = 1, $p = 0.54$). Notably, within the five county area DCPs were essentially issued whether the cattle producer requested them or not (Table 1), and relied on voluntary compliance of the permittee with the requirement to sign and return the permit.

How did liberalized distribution affect the seasonal use of DCPs? Prior to 2008, the seasonal use of DCPs and other OOS shooting permits for deer was controlled by limiting the period during which the permit was valid, effectively preventing them from being used during the autumn hunting seasons (as what some hunters have termed “free hunting licenses”). Depending upon the area/landowner type, the time period for which DCPs were valid varied during the period of liberalized distribution (Table 1). For cattle and bison producers in the five county TB endemic area and in Shiawassee County, DCPs were valid to take deer yearround. Over the period 2008-2010 within the five county area, more than half (52%) of the deer reported shot on DCPs were taken between October 1 and December 31, i.e., during open deer hunting seasons. Sixty percent of the permittees who reported shooting deer took them only during that period (Fierke, 2008, 2009, 2010). Comparable proportions in Shiawassee County were 63% and 76%, respectively. In the other two area/landowner types, the majority of deer shot during the period of liberalized distribution were taken in the first quarter of the year. In the MAZ outside the five county area, 57% of deer shot on DCPs were taken between January 1 and March 31 by 69% of the permittees who took deer at anytime during the year. Among non-agricultural landowners in DMU 452, comparable figures were 82% and 90%, respectively. Culls/herd health checks carried out in February of each year by a single deer hunt club comprised most (282/461; 61%) of the deer reported shot. These data suggest that where permittees were allowed to take deer during regular hunting seasons, they preferentially did so. Where that season was off limits, most deer were taken in the winter months.

Cross-referencing the DCP permit holder database with hunting license sales records provides another insight on seasonal use trends over the period. Three hundred twenty-five unique

permit holders shot at least one deer on DCPs 2008-2010. Eighty six percent of those were agricultural producers. Among the 325 permittees who shot at least one deer, 217 (67%) had bought at least one deer hunting license for the 2007 deer season (i.e., the year prior to the onset of liberalized DCP distribution). Of those 217, a significantly lower proportion (82%, 80% and 80%, 2008-2010, resp.) bought hunting licenses during the period of liberalized DCP distribution (Fisher's exact, two-tailed $p = 2.7 \times 10^{-16}$), although there was no evidence of a decreasing trend within the liberalized distribution period itself ($\chi^2 = 0.6$, df = 2, p = 0.74). Of the 108 permittees who did not buy at least one deer hunting license in 2007, significantly increased proportions (7%, 6% and 12%, 2008-2010, resp.) began buying them during the period of liberalized DCP distribution (Fisher's exact, two-tailed p = 0.0007), but again, there was no evidence of an increasing trend ($\chi^2 = 3.2$, df = 2, p = 0.21). Even accounting for those permittees who began purchasing licenses during the period, there was still a significant ($\chi^2 = 10.7$, df = 3, p = 0.01) net decrease in the deer license purchases (-9%, -12% and -9%, 2008-2010, resp., compared to 2007) for the DCP holders as a whole. In addition, among those who did buy deer hunting licenses while holding DCPs, the annual mean number of licenses bought decreased from 4.6 in 2007 to 4.4, 4.1 and 3.8, 2008-2010, respectively, a significant decrease from 2007 to 2010 (Wilcoxon signed-rank $p < 0.0001$).

Did liberalized distribution of DCPs result in the killing of more TB-positive deer? In the five county endemic area, there was no significant difference in the proportion of TB-positive deer taken on OOS shooting permits during the period of liberalized DCP distribution (4/1430, 0.28%) versus the comparison time period of 1998-2006 (3/1542, 0.19%, Fisher's exact, two-tailed p = 0.72). Further, the proportion of TB-positive deer among those shot under DCPs issued to five county agricultural producers (4/1430, 0.28%) was significantly lower than the proportion amongst hunter-harvested deer during the same time period in the same area (71/8826, 0.8%; Fisher's exact, two-tailed p = 0.03). These data provide little support for the idea that deer shot via DCPs on farms may be more likely to be TB positive, or that liberalized distribution of DCPs is likely to increase the proportional kill of TB-positive deer.

Non-agricultural landowners in DMU 452 shot more than twice as many TB-positive deer (12/461, 2.6%) than all the other area/landowner types combined (5/2331, 0.21%). Unfortunately, no comparison historical dataset of OOS permits issued to non-agricultural landowners exists with which to compare these figures. This greater efficiency of non-agricultural landowners, many of them hunt clubs, likely stems from their concentration in the core outbreak area, where prevalence of TB in free-ranging deer is the highest (O'Brien et al., 2002, 2006).

Did liberalized distribution of DCPs reduce the probability that cattle herds would become TB-infected? The mean number of cattle herds infected with TB annually was 3.8 herds/year 1998-2007 and 2.0 herds/year 2008-2010 in the five county endemic area, and 0.5 herds/year 1998-2007 and 0.7 herds/year 2008-2010 in the MAZ counties outside the five county area. There was little distance between the best and worst approximating models in either of the two areas (Table 4). In general, the fit of the model for the MAZ counties outside the endemic area was poor, with large standard errors on the parameter estimates. Across both of the areas examined, only one of the six candidate models examined contained any significant predictors of the annual number of TB-infected herds, and that model was not the best fit to the data as measured by AIC_cs. Thus, at this level of analysis at least, there is little evidence that liberalized distribution of DCPs was associated with a substantial decrease in transmission of TB to cattle.

Did cattle producers whose herds had been TB-infected, or became TB-infected, use DCPs? The economic and psychological hardship posed by having ones cattle herd become infected

with TB is unquestionably substantial. Consequently, one might expect those farmers whose herds have been TB-infected to have heightened awareness of the risks of TB transmission from deer, and perhaps be more likely to take advantage of opportunities to shoot deer on their farms. Thus it is reasonable to examine the use of DCPs by cattle producers whose herds were infected, both during the period of liberalized distribution, and prior to it.

To the date of this writing (5/12/2011), 53 cattle herds and 4 captive cervid herds have been infected with TB since June, 1998. Six of the cattle herds were farms that had been infected for the second time, and one farm was infected a third time. Subtracting these repeat infections on the same premises from the total leaves 46 unique cattle farms potentially eligible for DCPs. Twelve of these premises were no longer in the MDA database of cattle operations (that was used for DCP mailings) at the outset of the liberalized distribution period, suggesting that there were no longer cattle present at those locations. The remaining 34 farms were eligible for DCPs. Of those, 31 were from the five county endemic area, and 3 were from the MAZ outside the five counties.

All of those 34 producers were mailed DCPs and kill tags in at least one of the three years (Table 5). A total of 656 kill tags were mailed over the period. Seventeen producers (50%) shot deer in at least one of the three years, killing a reported 228 deer overall. Only 3 (9%) of those cattle producers mailed DCPs used the services of USDA APHIS WS to shoot deer on their properties. Of the 17 producers who took deer in at least one of the three years, the median number of deer killed over the three year period was 6 (range: 1-91, first quartile = 2, third quartile = 9). Among those 34 cattle producers that were mailed DCPs in at least one of the three years, 24 (71%) received DCPs all three years. Of those 24, only 8 (33%) returned a signed permit to the DNR WDL each year, and only 3 (13%) shot deer each year, taking 3, 24, and 91 deer each over the course of the three year period. Shooters from USDA APHIS WS were used by the producer who took 91 deer.

Table 5. Use of Disease Control Permits during the period of liberalized distribution by 34 cattle farms infected with bovine TB between 1998 and 2010.

	2008	2009	2010	Mean
Mailed DCPs	29 (100%)	30 (100%)	28 (100%)	29 (100%)
Returned signed DCP to DNR	21 (72%)	21 (70%)	12 (43%)	18 (62%)
Killed deer on DCPs[1]	11 (38%)	9 (30%)	7 (25%)[1]	9 (31%)

[1] *Three additional producers took deer illegally without having returned a signed DCP to the DNR WDL.*

What were the costs of administering the liberalized distribution program compared to previous administration in the field? Prior to 2008, the DNR WDL played little role in the administration of DCPs. Activities handled by field staff included administration, phone communications, occasional meetings, site visits to deliver the permit or investigate complaints, and pick up and transport of deer heads for TB testing. Transport of heads was a particularly time-consuming endeavor, with DNR staff initially making trips to farms for head pickup, prior to the establishment of head drop off points for DCP holders. However, during the period of liberalized distribution, most of the responsibility for program administration (with the exception of site visits) was reassigned from the NEMU to the Lab by the DNR Director. Despite the shift in responsibility, there was little difference in the mean annual wage costs for the period of liberalized distribution ($31,807) compared to the historic period of DCP distribution ($32,688), amounting to approximately a 2.7% decrease (Table 6). As a whole, Wildlife Division staff hours expended were reduced substantially however, from an annual mean of 1,299 hours

2001-2007, to 863 hours 2008-2010, a decrease of approximately 34%. In spite of that overall reduction, however, for a core group of NEMU field staff, hours expended on DCPs actually increased from 2007 to 2009, suggesting that liberalized distribution did not entirely disencumber field staff, despite the transfer of administrative duties to the Lab.

DISCUSSION

In evaluating the liberalized distribution of DCPs, it is well to consider what factors precipitated the programmatic change, and what effects the change was intended to bring about. First, an obvious objective for policymakers was to increase the issuance of permits to address the expressed concern of agricultural producers that they could not obtain (or at least easily obtain) DCPs to control deer numbers on their land. Having distributed >2300 permits and >13,000 kill tags over the three year period of liberalized distribution, there can be little doubt that this objective was achieved, and constituted an ~15X and ~10X increased annual availability for DCPs and kill tags, respectively, for agricultural producers in the TB endemic area (Table 3). Agriculture producers in the five county endemic area had only to wait for the permit and kill tags to arrive via the mail, and to sign and return the permit to make it legal. Yet surprisingly, less than 40% of those producers returned signed permits; liberalized distribution effectively decreased regulatory compliance with the terms of DCP issuance. Moreover, <4% of five county agricultural producers requested additional (beyond the original five issued) kill tags, suggesting the actual demand for DCPs was considerably lower than had been publicly claimed by cattle producers and livestock advocacy groups. Thus, liberalized distribution greatly increased the *opportunity* for DCP use, but the actual use of DCPs increased the deer kill minimally (0.3%, not significant statistically), and considerably lowered the proportion of DCPs actually used to kill deer[2]. The criteria for issuance of DCPs in the remainder of the MAZ outside the five counties left more discretion to the area biologist (Table 1), yet still resulted in the issuance of >350 DCPs in three years, in addition to OOS shooting permits issued for other reasons (e.g. crop damage). This amounted to a quadrupled annual availability of DCPs, and tripled the annual availability of kill tags. Liberalized distribution also dramatically increased access to DCPs for non-agricultural landowners (such as hunt clubs) in DMU 452, where the prevalence of TB in free-ranging deer is the highest.

Second, it was hoped that liberalized distribution would assist in further reducing TB in the free-ranging deer herd and help reduce the risk of transmission of TB from deer to cattle. However, the data evaluated provide little evidence that these objectives were accomplished. Liberalized distribution did not significantly increase the killing of TB-positive deer in the five county endemic area, and agricultural landowners in the endemic area with DCPs shot TB-positive deer at a significantly lower rate than licensed hunters. Indeed, only 17 of 34 (50%) participating TB-infected farms shot any deer at all on DCPs, and three quarters of those shot nine deer or less over the three year period of liberalized distribution. Even with DCPs easily available, only three TB-positive farms shot deer every year. Among those groups that were issued DCPs under liberalized distribution, non-agricultural landowners in the DMU 452 killed more than twice the number of TB-positive deer as all the agricultural groups combined. Further, Poisson regression modeling showed little evidence that the time period of liberalized DCP distribution was associated with a significant decrease in the number of TB-positive cattle herds. Time period was not a significant predictor at all in the MAZ counties outside the endemic area, and was not a consistently significant predictor even within the endemic area.

[2] One could argue that because the DCP program cannot absolutely verify the number of deer killed (because numbers relies on the veracity of permitees' reporting), that deer kill figures in this report are an underestimate. Such an argument would presume however that permittees were deliberately underreporting/not reporting all the deer they killed, i.e., they were taking deer illegally, an obvious violation of the terms of the DCPs.

Even if a consistent time period effect had been found, it would have been difficult to attribute that effect solely to liberalized DCP distribution. Confounding factors at work during the same time period (e.g., on-farm risk mitigation) could have accounted for the effect observed. However, the fact that time period was not a consistently significant predictor in the best-fitting models suggests that liberalized DCP distribution likely had minimal, if any, influence on the risk of TB transmission from deer to cattle. Thus, these data suggest that deer shot on farms on DCPs are not more likely to be TB-positive, and that liberalized distribution of DCPs is unlikely to increase the killing of TB-positive deer.

Third, liberalized distribution of DCPs was intended to supplement, not replace, the deer kill attributable to hunter harvest. Since the inception of Michigan's bovine TB eradication project, hunter harvest has been one of DNR's two primary eradication strategies (Schmitt et al., 1997; O'Brien et al. 2006), and the obligate tool by which publicly-owned free-ranging deer populations are managed. The necessity of agricultural producers' (or any other landowners experiencing deer damage) cooperation with hunters is implicit in any discussion regarding management of deer numbers. However, these data suggest that liberalized distribution to agricultural producers often resulted in deer being killed on DCPs during normal hunting seasons in autumn. Prior to 2008, the effective dates DCPs were valid generally ended prior to the first deer hunting season of the year, in late September. This was purposely done to prevent DCPs from being used to replace purchased hunting licenses as a means to legalize take. During the period of liberalized distribution, where DCPs were legal to use during the autumn months (for agricultural producers in the five county endemic area and in Shiawassee County), the evidence clearly shows that the majority of the deer killed were shot from October 1 to December 31. Moreover, most of the permittees who shot deer did so exclusively during the autumn deer hunting seasons. In addition, there was a significant decrease in the proportion of agricultural landowners who purchased deer hunting licenses once they had access to DCPs, and those who still purchased hunting licenses purchased significantly fewer once DCPs were available. The argument could be made that evaluating more than a single year's (2007) license purchases as a control might alter the results. Nonetheless, these findings lend support to the often expressed concern of hunters and some wildlife managers that if permitted, DCPs will be used as "free hunting licenses." Notably, where permit conditions did not allow the use of DCPs during legal hunting seasons, the DCPs were still used, but typically during the winter months. So, to the extent that liberalized distribution of DCPs was intended to supplement hunter harvest, it was unsuccessful.

Fourth, although not unique to the liberalized distribution program, current DNR and State of Michigan policies constantly set objectives to achieve programmatic efficiencies and cost savings wherever possible. The crude cost assessment presented here suggests that liberalized distribution of DCPs reduced wage costs minimally (<3%), but reduced staff hours expended more substantially (34%). A more thorough cost comparison would also need to incorporate the loss of revenue to DNR from hunting licenses that were no longer bought by DCP holders once liberalized DCP distribution began.

Although much more difficult to evaluate systematically and objectively, the success of liberalized distribution in the eyes of stakeholders may carry more weight with policymakers than do scientific data. We did not attempt to systematically survey stakeholder groups or the public concerning liberalized distribution, but the topic spontaneously evoked many comments over the three year period. As might be expected, opinions among livestock producers were generally, although not exclusively, positive. For example, one cattle producer characterized liberalized distribution as "the best thing that ever happened on our farm". That individual expressed the opinion that his ability to shoot deer on DCPs, combined with protective fencing, prevented most deer damage to stored forages. He remarked that prior to liberalized

distribution, it was “a constant hassle” with the area DNR biologist to get DCPs, to the point that he simply no longer sought them. Other concerns included his perceived potential liability for carcasses of DCP-shot deer that must be donated to charity, and the need to “sell” the program more to farmers to increase participation. A Montmorency County cattle producer remarked that his use of DCPs was changing deer behavior on his farm, noting an approximately 80% reduction in the number of deer he saw cleaning up spilled cattle feed at night. Yet surprisingly, other cattle producers expressed opinions well summarized by a Presque Isle County cattle producer who returned his DCP permit package to the WDL, noting he had no need for it because all the deer were now gone.

Conversely, comments received from many deer hunters and from some local residents (as reported by DNR field staff) were overwhelmingly negative. While acknowledging the need for producers to protect their cattle, frequent, and recurring, themes included: the unfairness of licensed hunters subsidizing cattle producers with “free deer licenses,” concerns that mass mailing of kill tags would excessively deplete deer numbers; concerns from landowners adjacent to cattle farms that those farms were shooting deer that would then be unavailable for hunter harvest (e.g., Figure 3); instances where bait was being used with DCPs in the area where baiting deer is banned; concerns that harassment of tuberculous deer on one farm using DCPs would drive those deer to adjacent farms where they would infect adjacent cattle; the devaluation of free-ranging deer as a resource to pest status; and perceptions that deer being shot on DCPs are wantonly wasted (gut shot, never recovered, buried, etc.) and far exceed numbers being reported killed by permittees. The data presented here suggest that some of these concerns are unfounded (e.g., concerns about depleting deer numbers), while others (e.g., “free deer licenses”) are not.

Figure 3. These five bucks were all legally taken on DCPs less than a month prior to the Youth deer hunting season in September 2011. The four in velvet were all shot by the same cattle producer in a single day. Although entirely in compliance with existing regulations, such situations are a sore point with many deer hunters and Conservation Officers who perceive them as examples of DCP holders “wasting” the most desirable bucks, which would otherwise be available for hunter harvest. The perception that DCP holders kill such deer deliberately to spite neighboring landowners and hunters adds to the ill will.

Over the period, DNR permit administrators and field staff documented rare instances of practices by landowners that portray the liberalized distribution program in a particularly negative light. For example, at least two landowners in the five county endemic area who had previously not owned cattle bought a cow so that they would qualify to shoot deer yearround on DCPs. An Alpena County cattle producer identified himself as a “freezer beef” operation to MDA in order

avoid TB testing his herd, yet insisted to DNR staff that he was not a freezer beef operation in order to qualify for yearround DCPs. Field staff making DCP-related farm visits remarked on the frequent use of the phrase "entitled to" by farmers, and the farmers' admission that they did not really have deer damage problems, but deserved permits nonetheless: "I don't see deer, but if I do, I will put one in the freezer." The hunting public undoubtedly also hears such comments. Other staff reported incidents of agricultural producers using DCPs to shoot deer illegally (e.g., submitting tagged deer heads for testing without having returned a signed permit, shooting deer over bait), and shooting deer on lands they owned, but where no cattle were located. Although at a population level such behavior is unlikely to negatively impact the deer herd biologically, what appears to be DNR's tacit encouragement of it becomes difficult to justify to deer hunters, particularly when those same hunters have been asked to tolerate lower deer numbers and bans on popular hunting practices such as baiting in order to lower TB transmission risks for the benefit of area cattle producers. Given that the cooperation of deer hunters in the TB endemic area will continue to be an absolute necessity to keep deer numbers, and TB transmission, from increasing, the potential costs of further alienating hunters should be weighed against the potential benefits of quieting discontented individuals by issuing them DCPs.

Enforcement of the regulations associated with liberalized distribution has not been without difficulty. The unsolicited mass mailing of kill tags to cattle producers has made it difficult for Conservation Officers to hold violators accountable for abuses of the DCP system. Officers face significant investigative hurdles when public complaints of violations of permit conditions are reported. Chief among these issues is the public perception, and in some instances the perception of court systems, that DNR has devalued these deer by making it as easy as possible for agricultural producers to shoot them under the authority of a liberalized permitting system. Prosecution of violations both related and unrelated to DCPs has suffered as a consequence. Additionally, Conservation Officers and WLD field staff felt that the system was implemented rapidly and on short notice with little background or guidance provided. Consequently, many officers lacked sufficient confidence to enforce regulations and permit conditions that were subject to change. Lastly, incidents arose where permittees were considered to be using DCPs injudiciously to compensate for perceived TB transmission risks brought on by questionable farm management practices. That is, DCPs were used in lieu of reasonable management practices which could have limited contact between free-ranging deer and cattle or their feed. These enforcement difficulties were also frustrating to WLD administrative staff, who spent large amounts of time maintaining permit databases, specifically in order to make them available and useful to Law Enforcement staff. Broad inter-Divisional access to permit information was insufficient to overcome the inherent enforcement challenges created by mass mailing of permits. This underscores the importance of seeking input from LED staff prior to implementation in order to maximize the enforceability of new regulations.

Consideration of issues of data comparability should be kept in mind when drawing conclusions about the utility and effects of DCPs during the liberalized distribution period. Out of season shooting permit data are gathered in the field by WLD biologists for counties they manage, and are compiled at the Management Unit level. Typically, records of DCPs have not been maintained separate from other types of OOS shooting permits, such as deer damage shooting permits. Consequently, the comparability of the DCP data reported here varies by geographic area. In the five county TB endemic area, the vast majority of OOS shooting permits issued since 1998 have been DCPs (E. Carlson, personal communication). Consequently, statistical comparisons between the period of liberalized distribution (2008-2010) and the previous decade are quite reasonable for the endemic area. However, in MAZ counties outside the endemic area, the majority of OOS shooting permits were issued as mitigation for crop damage, and so statistical comparisons for those counties may be less reliable. For DCPs issued to non-agricultural landowners in DMU 452, there simply is no good data to use for comparisons, as

OOS shooting permits were not routinely issued to those landowners prior to the period of liberalized distribution, and DMAs were additional purchased hunting licenses used to take deer during hunting seasons. Finally, analysis of data on hunting license purchases of DCP holders from DNR's RSS were limited to family members, and did not identify purchases by non-family designated shooters.

In addition, the comparison of costs for the program are only approximate. Our analysis considered only wages and salaries of Division staff. Fringe benefits, supplies, postage, vehicle maintenance costs for field staff, etc., were not included, as no comprehensive data were readily available. It seems likely that actual costs were higher than those noted here, although whether there was any differential bias between costs of NEMU field staff versus Lab staff that would have significantly affected comparisons is unknown.

RECOMMENDATIONS

1. *Disease control permits are, in the hands of those livestock producers who use them as they were intended, a useful supplementary tool for harassment of deer away from cattle, feeding and feed storage areas on farms.* Assertions concerning their other supposed benefits for curbing disease transmission are unfounded. They should remain readily, but not gratuitously, available to those who need them.
   However, who should determine what constitutes "need?". Even as authors of this report, we could not reach consensus. One viewpoint held that need should be determined by DNR field staff knowledgeable of the farm, the transmission of TB to livestock, and ideally, impartially perceptive to the opinions of cattle producers, deer hunters, and owners of non-agricultural land. The other maintained that if TB eradication is in fact still a goal in Michigan, DCPs should be available to all cattle producers in the five county endemic area, with or without the approval of the local DNR field biologist. The rationale for this latter view was that determination of need unnecessarily consumes the time of DNR field staff, time better spent on more pressing concerns. Moreover, restricting DCPs to some individuals and not others invites the kind of public complaints which at least partially precipitated the liberalized distribution trial in the first place. In the end, how 'need' is to be determined may always fall to policymakers rather than field or scientific staff.

2. *Restrict the use of all DCPs to the period from termination of the last deer hunting season to, but not extending into, the beginning of the first deer hunting season. Given current season dates, such an effective period for DCPs might run from January 1 through August 31., Exceptions should be made on a case by case basis only where there is a compelling disease concern.* Findings from this analysis clearly demonstrate that where DCPs are allowed to be used as a no cost substitute for purchased hunting licenses, they are. The purpose of DCPs, as with OOS shooting permits and DMA permits, is to supplement hunter harvest of deer, not replace it.

3. *Limit automatic mailing of permits and kill tags to those existing permitees with a demonstrated history of compliance with permit conditions (including returning a signed permit) and consistent killing of deer in excess of what can reasonably be accomplished via hunter harvest (i.e., more than one or two deer per year).* The mass mailing of DCPs systematically distributed thousands of permits and kill tags to a large group of individuals who apparently did not want them and certainly did not use them (at least not legally), with little leverage to DNR for enforcement of permit conditions. This well-intentioned but overly simplistic reaction to the complaints of a relatively small number of

individuals unintentionally alienated many deer hunters and landowners upon whom, for better or worse, TB control efforts are likely to rely for years to come.

4. *Among agricultural landowners, restrict the issuance of DCPs to livestock producers.* Disease control permits were not intended as substitutes for deer damage shooting permits to manage deer causing agricultural or horticultural crop damage. Claims of solidarity by non-livestock owning agricultural producers with cattle producers are insufficient justification.

5. *Search for procedural methods to 1) streamline the administrative burden associated with DCPs, such as making permits valid for periods longer than 1 year; and 2) increase enforceability of permit conditions.* Currently, more individuals and more agencies are involved with issuance of DCPs than is necessary. For example, although DNR WDL staff currently oversee distribution of most DCPs for both agricultural and non-agricultural landowners in the TB endemic area, there is nothing inherent to administration of these permits that necessitates the unique expertise of lab staff. It could be argued that these functions more sensibly belong where they originally were, in the field where the permits are used, rather than 150 miles away in Lansing. In addition, programs residing in other agencies such as MDA that recommend that cattle producers use DCPs could facilitate that use by making routinely collected data available to DCP administrators. For example, during their on-farm surveys of cattle management and facilities, MDA and its wildlife risk mitigation program partners in the USDA's Natural Resources Conservation Service (NRCS) often encourage producers to use DCPs to harass deer on their farms. Those surveys collect and document most of the information necessary for DNR administrators to issue DCPs (location, contact information, counts of livestock, etc.). Currently, MDA and NRCS leave it to the producers to contact DNR to obtain permits. Once that contact occurs, DNR staff must contact MDA to obtain necessary information. A potentially more efficient alternative would be for MDA to routinely share the findings of their on-farm surveys with DNR, perhaps via a shared computer network drive, who could then issue DCPs to the producers in a more timely fashion.

   Extension of the term of DCPs to longer periods (such as to the length of time for which the cattle producer's MDA wildlife risk mitigation plan is valid) should be contingent on demonstrated compliance with permit conditions, and verifiable methods to update DNR records when producers no longer have cattle on the permitted premises. The ability to credibly demonstrate effective enforcement of DCP conditions, while unlikely to have any biological effect on the deer population, may nonetheless help improve negative perceptions of the program on the part of hunters and non-agricultural landowners.

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Table 1: Summary of guidelines for issuance[1] of Disease Control Permits (DCPs) through 2010

Landowner type	Geographic area			
	Deer Management Unit (DMU) 452	Five county[2] area outside DMU 452	Remainder of Modified Accredited Zone (MAZ)[3]	MI Dept. of Agriculture Moderate Risk area[4]
Cattle & bison operation (≥ X head)	–Direct mailed permits by DNR Lab in January –Valid for 365 days	–Direct mailed permits by DNR Lab in January[4] –Valid for 365 days	–Mailed invitation letter by DNR Lab in January –Issued upon request without further review –Valid for 120 days with extension possible[5]	–Issued at the discretion of local DNR biologist, on request of landowner –Valid for 120 days with extension possible[5]
Other livestock & non-livestock agricultural operation (e.g. orchards, crop farms)operation	– Issued upon request without further review –Valid for 120 days with extension possible[5]	–Issued at the discretion of local DNR biologist, on request of landowner –Valid for 120 days with extension possible[5]	–Issued at the discretion of local DNR biologist, on request of landowner –Valid for 120 days with extension possible[5]	DCPs not available
Non-agricultural	–Selected hunt clubs mailed invitation letter by DNR Lab in January; others may request –Issued upon request without further review –Valid for 120 days with extension possible[5]		–Issued at the discretion of local DNR biologist, on request of landowner –Valid for 60 days with extension possible[5]	DCPs not available

*[1] Issuance of **all** permits subject to DNR Law Enforcement approval (permits will **not** be issued to convicted felons or violators of conservation laws).*
[2] Alcona, Alpena, Montmorency, Oscoda, and Presque Isle Counties.
[3] Antrim, Charlevoix, Cheboygan, Crawford, Emmet, Otsego Counties and portions of Iosco and Ogemaw Counties north of the southernmost boundary of the Huron National Forest and Au Sable State Forest.
[4] Arenac, Clare, Gladwin, Grand Traverse, Kalkaska, Missaukee, Osceola, Roscommon and Wexford Counties and portions of Iosco and Ogemaw Counties south of the southernmost boundary of the Huron National Forest and Au Sable State Forest.
[5] Not valid during deer hunting seasons.

Table 3: Summary of Disease Control Permits (DCPs) issued during the liberalized distribution period by area and calendar year.

	Deer taken [# TB +]	% of kill tags filled	Permittees taking deer (% of total)	Letters of invitation mailed	Permits mailed /issued	Kill tags mailed/ issued	Signed permits returned (% of total)	Permittees requesting more kill tags (% of total)
Five county[1] Agricultural Producers								
2008	663 [1]	18%	185 (28%)	NA[3]	664	3596	273 (41%)	28 (4%)
2009	453 [0]	16%	125 (24%)	NA	513	2821	196 (38%)	27 (5%)
2010	314 [3]	11%	108 (21%)	NA	521	2747	179 (34%)	16 (3%)
Total 2008-2010	**1430 [4]**		**418**	**NA**	**1698**	**9164**	**648**	**71**
mean	*477 [1.3]*	*15%*	*139 (24%)*		*566*	*3055*	*216 (38%)*	*24 (4%)*
Mean, 1998-2006[2]	90 [0.2]	27%		NA	38	294	38 (100%)	ND[4]
NE Agricultural Producers Outside the Five County Area								
2008	183 [0]	59%	26 (67%)	0	39	312	38 (97%)	10 (26%)
2009	232 [0]	25%	46 (30%)	305	153	935	108 (70%)	16 (10%)
2010	199 [1]	20%	49 (29%)	317	169	981	92 (54%)	16 (9%)
Total 2008-2010	**663 [1]**		**121**	**622**	**361**	**2228**	**238**	**42**
mean	*221 [0.3]*	*34.6%*	*40 (34%)*	*311*	*120*	*743*	*79 (74%)*	*14 (15%)*
Mean, 2001-2006[2]	100 [0.2]	42%		NA	29	242	29 (100%)	ND
Non-agricultural Landowners, DMU 452								
2008	113 [5]	38%	13 (50%)	98	26	295	20 (77%)	5 (19%)
2009	205 [3]	48%	16 (53%)	165	30	428	22 (73%)	3 (10%)
2010	143 [4]	35%	15 (41%)	151	37	410	27 (73%)	0 (0%)
Total 2008-2010	**461 [12]**		**44**	**414**	**93**	**1133**	**69**	**8**
mean	*154 [4]*	*40.3%*	*15 (48%)*	*138*	*31*	*378*	*23 (74%)*	*3 (10%)*
Shiawassee Agricultural Producers								
2008	97 [0]	30%	28 (50%)	150	56	325	39 (70%)	6 (11%)
2009	92 [0]	35%	26 (50%)	129	52	265	36 (69%)	5 (10%)
2010	49 [0]	19%	19 (41%)	137	46	260	29 (63%)	3 (7%)
Total 2008-2010	**238 [0]**		**73**	**416**	**154**	**850**	**104**	**14**
mean	*79 [0]*	*28%*	*24 (47%)*	*139*	*51*	*283*	*35 (67%)*	*5 (9%)*
Mean, 1998-2006[2]	27 [0]	60%	88%	NA	6	45	6 (100%)	ND

[1] *Alcona, Alpena, Montmorency, Oscoda, Presque Isle.*

[2] *Numbers reflect all out of season shooting permits pooled; data on DCPs were not maintained separately during the period.*
[3] *Not applicable.*
[4] *No data.*

Table 4: Summary of Poisson regression analyses:. competing models, numbers of estimated parameters (K), model selection results (AIC_c), difference from the best approximating model (Δ_i), model weights (w_i), and significant predictors of the annual number of TB-positive cattle herds diagnosed in northern Lower Michigan, 1998-2010.

Five county (FC) TB endemic area

Competing models[a,b]	*K*	AIC_c	Δ_i	w_i	Significant[c] predictors
FCPosHerds ~ Timeperiod + offset(FCWholeHerdTests)	3	62.669	0	0.43	None
FCPosHerds ~ Timeperiod + FCPrev + offset(FCWholeHerdTests) [global model]	4	62.796	0.127	0.40	Timeperiod
FCPosHerds ~ FCPrev + offset(FCWholeHerdTests)	3	64.469	1.8	0.17	None

Modified-accredited zone counties outside the five county (OFC) endemic area

Competing models[a,b]	*K*	AIC_c	Δ_i	w_i	Significant[c] predictors
OFCPosHerds ~ Timeperiod + offset(OFCWholeHerdTests)	3	21.754	0	0.49	None
OFCPosHerds ~ OFCPrev + offset(OFCWholeHerdTests)	3	22.850	1.096	0.28	None
OFCPosHerds ~ Timeperiod + OFCPrev + offset(OFCWholeHerdTests) [global model]	4	23.333	1.579	0.22	None

[a] Models with $\Delta_i \leq 2$ compared to the best approximating model (Burnham and Anderson, 1998, p. 48).
[b] Covariates included timeperiod of Disease Control Permit (DCP) distribution (1998-2007 vs. 2008-2010) and apparent prevalence of TB in free-ranging white-tailed deer (Prev) as predictors, with the number of whole cattle herd TB tests (WholeHerdTests) included as an offset parameter (Venables and Ripley, 2000, p. 189).
[c] $P \leq 0.05$.

Table 6. Wages (in dollars) associated with Disease Control Permit administration by DNR Wildlife Division Northeastern Lower Peninsula Management Unit (NEMU) and Wildlife Disease Lab staff 2001 through 2010.

Unit	Staff	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
NEMU	Natural Resource Manager-3	2,738	1,476	985	1,783	956	670	2,568	1,693	647	326
NEMU	Wildlife Assistant-E	4,534	3,032	4,283	1,100	1,481	253	519	973	1,540	458
NEMU	Wildlife Biologist-A			42	360	1,394	3,869	5,659	7,719	5,983	7,124
NEMU	Wildlife Biologist-E	13,295	6,377	10,911	3,148	3,197	227	464	304	1,958	692
NEMU	Wildlife Technician-E	13,447	4,562	5,396	2,290	4,237	3,389	3,144	3,386	4,460	2,837
NEMU	Wildlife Technician-SS				489						
NEMU	Wildlife Biologist-LTE	13,579	12,707								
NEMU	Wildlife Assistant-Non-Career E		2,312	4,057							
NEMU	State Worker				61						
NEMU	Parks & Recreation Ranger-Seasonal E				371						
NEMU	Wildlife Assistant-Seasonal E	28,749	21,175	20,939	5,606	6,983				11,174	
Lab	Laboratory Scientist-E								20,420	7,761	6,501
Lab	Laboratory Technician-E								1,362	2,555	2,555
Lab	Secretary-A								1,197	997	798
	TOTAL	**76,342**	**51,641**	**46,613**	**15,208**	**18,248**	**8,408**	**12,354**	**37,054**	**37,075**	**21,291**
	Mean							***$32,688***			***$31,807***

Table 7. Hours associated with Disease Control Permit administration by DNR Wildlife Division Northeastern Lower Peninsula Management Unit (NEMU) and Wildlife Disease Lab staff 2001 through 2010.

Unit	Staff	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
NEMU	Natural Resource Manager-3	76	8	31	58	29	18	69	103	17	8
NEMU	Wildlife Assistant-E	249	19	210	63	58	13	23	170	70	21
NEMU	Wildlife Biologist-A			2	22	50	105	169	417	162	194
NEMU	Wildlife Biologist-E	530	57	396	132	110	10	19	14	84	28
NEMU	Wildlife Technician-E	656	35	255	140	140	143	135	297	175	123
NEMU	Wildlife Technician-SS				23						
NEMU	Wildlife Biologist-LTE	521	144								
NEMU	Wildlife Assistant-Non-Career E		130	160							
NEMU	State Worker				8						
NEMU	Parks & Recreation Ranger-Seasonal E				24						
NEMU	Wildlife Assistant-Seasonal E	2,113	578	827	366	157			192	513	
Lab	Laboratory Scientist-E								713	271	227
Lab	Laboratory Technician-E								80	150	150
Lab	Secretary-A								48	40	32
	TOTAL	**4,145**	**971**	**1,881**	**836**	**554**	**292**	**415**	**1,193**	**1,021**	**374**
	Mean							***1,299***			***863***

Addendum 1.

STATE OF MICHIGAN

DEPARTMENT OF NATURAL RESOURCES & ENVIRONMENT

LANSING

JENNIFER M. GRANHOLM
GOVERNOR

REBECCA A. HUMPHRIES
DIRECTOR

June 20 2013

Mr./Ms. «first_name» «last_name»
«address»
«PREMISEScity», MI «zip»

Dear Mr./Ms. «last_name»:

Bovine tuberculosis (TB) continues to be a concern in free-ranging deer of northeast Michigan. Disease Control Permits (DCP) were created to assist landowners in managing deer on their property, and to specifically address the transmission of the disease between free-ranging deer and livestock. We ask and encourage you to participate in the State of Michigan's Bovine Tuberculosis Eradication Program by using the permit tags and requesting more when needed. Please see the enclosed permit for complete instructions.

White-tailed deer are the maintenance host and the only known wildlife reservoir for bovine TB in the Michigan outbreak. If eradication of TB is to be achieved, control strategies must include focusing on the disease in deer. To help control the transmission of TB to livestock, the Department of Natural Resources & Environment (DNRE) is providing producers in areas of the northern Lower Peninsula additional opportunity to take deer on their property. Enclosed is a DCP (2 copies) in your name that is valid through December 31, 2011 for your property, as listed on the permit. You may designate up to three (3) additional shooters to assist you. If you want to use the tags listed on the permit, ***you must return one signed copy of the DCP,*** with the names and addresses of any designated shooters in the enclosed self-addressed, stamped envelope. If you decide not to use the permit and tags, please promptly return them to the DNRE Wildlife Disease Laboratory.

Please note that all deer heads, *with antlers still attached*, must be submitted to the DNRE for laboratory testing. **The entire head of bucks shot under DCP will be turned over to the DNRE. Antlers will not be returned.**

On behalf of the Department, I want to thank you once again for your cooperation with the TB eradication effort. Without the continued help and support of stakeholders like you, it would be impossible for us to manage this disease in our livestock and wild deer.

Sincerely,

Stephen M. Schmitt, D.V.M.

Stephen M. Schmitt, D.V.M.
Wildlife Veterinarian-in-Charge
DNRE Wildlife Disease Laboratory

Contact Information for Disease Control Permits (monitored during normal business hours):

DCP Telephone: **(517) 336-5054** DCP Email: **DNR-DCP@michigan.gov**

Disease Control Permit (DCP): Overview of Your Responsibilities

- *By accepting and signing your DCP, you become legally responsible for complying with all of its conditions.* Be sure you and your designated shooters read and completely understand all of the provisions described on both sides of your permit. They must have a copy of the signed permit and an unused DCP tag in their possession while in the field.

- *All deer heads, with antlers still attached, must be submitted to the DNRE for TB testing*. **Antlers will not be returned. You are required to deliver the deer head to a DNRE field office or checkstation.**

- Fill out the white TB specimen tag (a permanent marker is preferred) and attach it securely around one jaw by making a cut through the hide. You may store deer heads in a freezer until it is convenient to deliver them to a DNRE field office or check station. Keep the tear off portion of the white specimen tag for your records; you may enter the number on the website www.michigan.gov/dnrelab to receive the TB testing results. The smaller portion of the cardboard DCP tag should be attached to the carcass.

- **Mail the larger postcard portion of the DCP tag to the Wildlife Disease Lab within 24 hours** of shooting the deer.

- Every reasonable effort must be made to retrieve any deer shot. All deer shall be properly field dressed and the filled out tag portion of the DCP tag attached to the *carcass* (not to the head).

- Inspect the chest cavity for signs of TB; the enclosed photos and instructions will assist you. Visible TB lesions are detected in less than one percent of the deer. If the deer is in poor condition or extremely skinny, do not cut into it. If you suspect TB based upon your initial inspection, stop field dressing the deer and replace any suspect organs back into the body cavity. Move the carcass to prevent contact by livestock, pets or scavengers. Attach the filled out white TB specimen tag to the jaw of the deer and use the DCP phone to report a suspicious carcass. Be sure to wash your hands well and launder any clothing exposed to the deer.

- The venison from deer taken under DCPs should not be wasted and should be kept by the landowner, the designated shooter, or donated to another person. The Michigan Sportsmen Against Hunger (MSAH) helps to coordinate the distribution of donated carcasses to food banks. Please contact this organization if you would like to donate at http://www.sportsmenagainsthunger.org or the MSAH Hotline: 517-853-FOOD (3663).

- The DCP telephone number [(517) 336-5054] and e-mail (DNR-DCP@michigan.gov) will be monitored by the DNRE Wildlife Disease Laboratory during normal business hours. Please use these contacts for requesting additional tags, for any questions, and for requesting changes in your permit information, such as:

    - If you own property with livestock on it that is not mentioned on your Permit and would like to use your DCP to take deer on that property as well.

    - To change your designated shooters.